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VARIATIONAL ANALYSIS OF 3-D FEL GAIN IN BEAM DISTRIBUTION APPROACH*

Ming Xie

Lawrence Berkeley Laboratory, MS-71H

Berkeley, CA 94720, USA.

(510) 486-5616

The variational method has been applied to calculation of 3-D free electron laser (FEL) gain [1,2,3]. Usually, the technique has been implemented to the self-consistent equation for the optical field. Here, we discuss a different approach in which the variational method is applied to the equation for the electron distribution function. The approach permits a simple derivation of a dispersion relation for the exponential growth rate taking into account the effects of beam energy spread, emittance and betatron oscillations. The approach also provides further insight into the selection of base for the orthogonal expansion method [4]. The variational solution is compared with the orthogonal expansion solution, and with the simulation using TDA [5].

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